Research on mango conducted by CIRAD in Réunion Island

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Small trees – High productivity: collaboration possibilities
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Presentation outline

Introduction

- What is CIRAD ?
- Research on mango in Réunion Island: objectives and approach

What has been done and what is in progress

- Vigour management
- Architecture
- Canopy light relations
- Crop load
- Modelling

What is CIRAD ?

- CIRAD = French Agricultural Research Centre for International Development (www.cirad.fr/en/)

- French research centre working with developing countries to tackle international agricultural and development issues

- Main issues: food security, ecological intensification, emerging diseases, the future of agriculture in developing countries

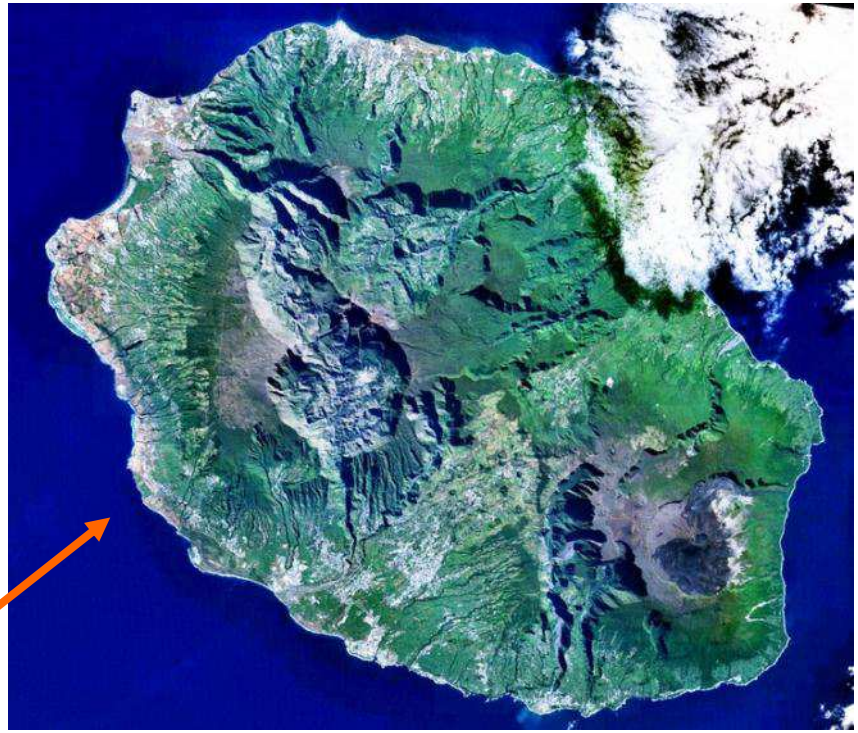
- 3 scientific departments

- 35 research units

- Main locations: Montpellier, French overseas regions,

- Joint operations with more than 90 countries

Research on mango in Réunion Island



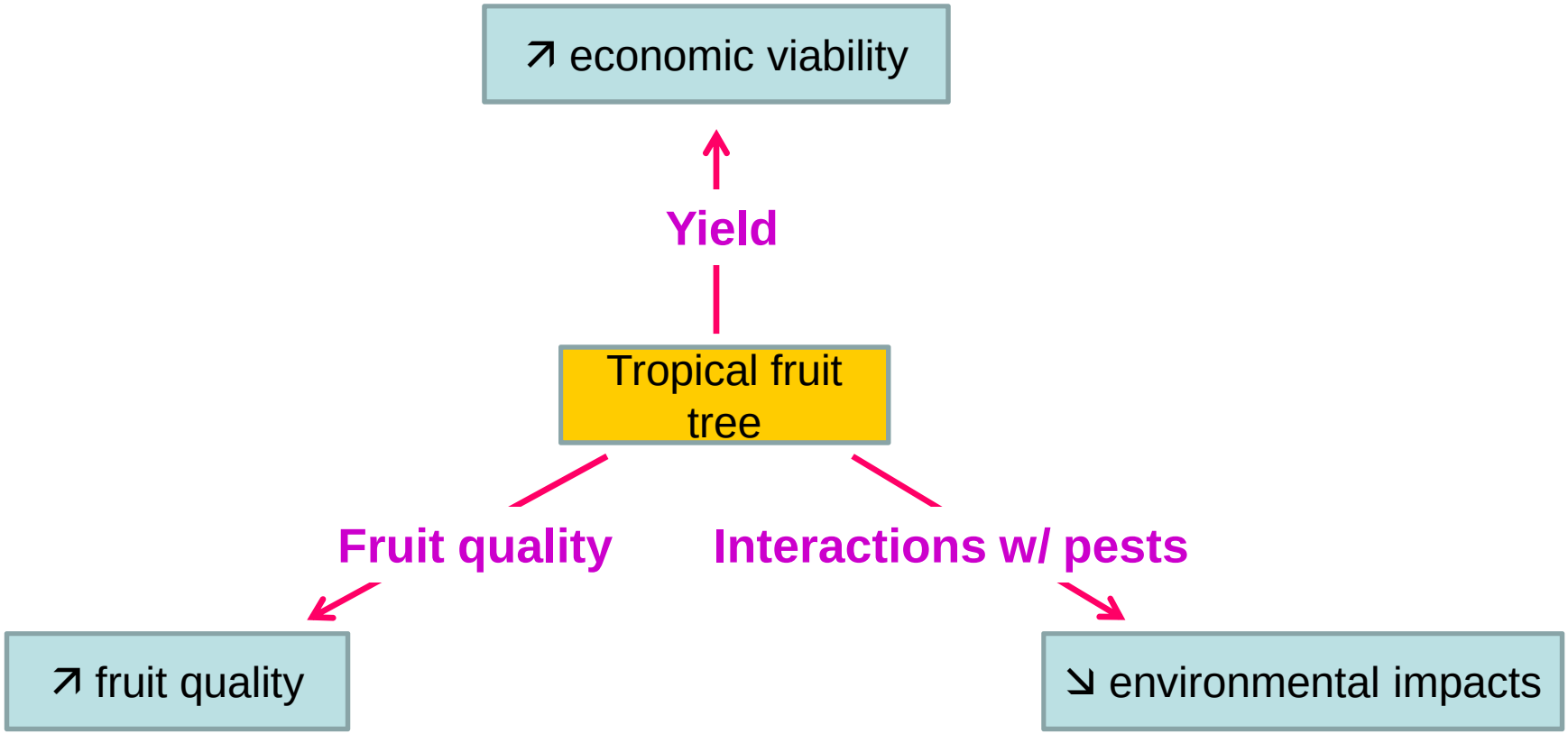
Area: 2512 km²

Population : 800 000 inhab

Tropical / subtropical climate

Research on mango in Réunion Island

Objective: to adapt the concepts of Integrated Fruit Production (IFP) to tropical trees (mango, pineapple, Citrus)



Research on mango in Réunion Island

The approach

1- to improve the knowledge on key processes for mango production: how does it work?, what are the factors affecting the processes?, processes modelling.

<u>The processes studied</u>:

- photosynthesis
- carbohydrates allocation
- architectural determinants of flowering and fruiting
- reciproqual interactions between vegetative and reproductive growth
- phenology
- fruit growth and quality build-up
- interactions between pests and mango

Research on mango in Réunion Island

The approach:

2- to deduce and experiment new tree management techniques complying with the objectives of IFP.

<u>The experiments in progress</u>:

- irrigation management
- pruning

Research on mango in Réunion Island

My research issues:

tree flowering, in relation to two agronomic problems

- irregular bearing
- phenological asynchronisms

• Nutritional approach (carbohydrates)

• Architectural approach → necessity to open the field of research to vegetative growth and phenology

• Modelling of mango tree phenology and yield

• Experiment new management techniques

What has been done and what is in progress

Vigour management

- rootstock control: ~ low vigour rootstock

- cultivar evaluation: assessement of vigour, canopy shape

- canopy manipulation: pruning experiment in progress
  - maintain reasonnable tree size,
  - synchronize tree phenology,
  - lessen irregular bearing.

- rootstock breeding: No

- growth regulators:
  - not allowed by phytosanitary regulations,
  - do not match with IFP concepts

What has been done and what is in progress

Architecture

- Patterns of natural development and fruiting (Normand et al., 2008, 2009, 2012; Dambreville et al., 2013) :
  - vegetative growth
  - interactions between vegetative and reproductive growth,
  - structural and temporal components,
  - ≠ levels: growth unit, scaffold branch, tree,
  - ≠ cultivars, including Kensington Pride

- Manipulation by pruning: effects on
  - vegetative development,
  - flowering and fruiting
  - fruit quality

- Manipulation by irrigation:
  - same observations as in the pruning experiment,
  - water balance model
  - water stress indicator (stem diameter microvariation)

What has been done and what is in progress

Canopy light relations

- Effect of light on fruit growth and quality (Léchaudel et al., 2005, 2007)

- Mango photosynthesis and effect of different factors
  - biochemical model of photosynthesis (Urban et al., 2003)
  - environmental factors, phenology, fruit load (Urban et al., 2004, 2005, 2006, 2007, 2008)
  - plant hydraulics and stomatal conductance (Damour et al., 2009, 2010)

- Mapping of mango dry mass and carbohydrates, changes during the growing cycle (in prep.)
  - main compartments for carbohydrates storage,
  - mobilization of carbohydrates during flowering and fruit growth,
  - contribution of reserves vs photosynthesis for fruit growth

What has been done and what is in progress

Crop load

- Understanding crop load effects on floral initiation, fruit set, irregular bearing and tree growth:
  - architectural approach (Dambreville et al., 2013),
  - interactions between fruit load and tree growth (cf pres. IHC)
  - work in progress (PhD Mathilde Capelli)

- Practical methods for load management
  - not explicitly experimented (i.e.removal of inflorescences to reduce asynchronisms)

What has been done and what is in progress

Modelling

- available models:
  - fruit growth and quality build-up (Léchaudel et al., 2005, 2007),
  - photosynthesis at the leaf level (Urban et al., 2003)
  - stomatal conductance (Damour et al., 2010)
  - thermal time models (growth units, fruits, inflorescences)

- in progress: modeling yield and fruit quality

What has been done and what is in progress

Modeling yield and fruit quality

Objectives :

- to model yield and quality build-up of the mango (Cogshall)
- to integrate the current knowledge
- to integrate some of the existing models
- to couple subsequently the model with a pest model
- to be able to simulate the impact of environment and cultural practices on development and performance of the mango tree

Expected outputs:

- phenology (within- and between-trees)
- yield
- fruit quality
- subsequently: pest damages

Collaborations

INRA, UMR AGAP (Montpellier), UR PSH (Avignon)

CIRAD / INRA / INRIA, Virtual Plants team

CIRAD, UMR PVBMT (Réunion island)

Universities (Réunion Island, Montpellier, Avignon)


Thank you for your attention

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